93 S611 Tech

U. S. DEPARTMENT OF COMMERCE

TECHNICAL NEWS BULLETIN

OF THE

BUREAU OF STANDARDS

ISSUED MONTHLY

Washington, October, 1932.—No. 186

CONTENTS

The reconvening of the International Commission for Uniform Methods of Sugar Analysis.
Second International Congress on Light.
Federal Fire Council activities.
Test methods for deformed concrete reinforcement bars.
Column curves and stress-strain diagrams.
Shear tests of reinforced brick masonry beams.
Colloid content of English china clays.
The system: $CaO—B_2O_3$.
Resistance of vanadium steel dies to abrasion by a plastic spark plug porcelain.
Sensibility to color differences.
Effect of variables in sensitization of photographic emulsions by dyes.
Liquids as electric insulators.
Isoelectric point of silk.
Physical properties of binder's board.
Experimental tests of mimeograph paper.
Determination of magnesia in phosphate rock.
Separation of rhodium from iridium and the gravimetric determination of metals.
Nickel chromium alloys for weights.
Standard time throughout the world.
New and revised publications issued during September, 1932.
Letter circulars.
Recent articles appearing in outside publications.

THE RECONVENING OF THE INTERNATIONAL COMMISSION FOR UNIFORM METHODS OF SUGAR ANALYSIS

The International Commission for Uniform Methods of Sugar Analysis deals with all matters of international importance relating to the scientific and technical aspects of the world's sugar industry, including standards, physical constants, and analytical methods. It is especially concerned with those factors which enter into the determination of value in the buying and selling of sugars. There have been seven previous sessions of the commission, the first being held in Hamburg in 1897, the last in New York in 1912. Owing to conditions which developed following the war it was found impossible, despite many urgent questions pressing for solution, for the commission to be reconvened.

As a result of numerous requests, including an urgent one made shortly before his death by Dr. Alexander Herzfeld, president of the commission, the Bureau of Standards, through Frederick Bates, chief of the bureau's polarimetric work, undertook the rehabilitation and reorganization of the commission. A comprehensive program was prepared covering 14 major subjects, and referees and associate referees from the world's leading authorities in each subject were appointed. After a year and a half of correspondence between these committees to eliminate minor international disagreements, the bureau made the announcement that the eighth session of the commission would be held in Amsterdam, the Netherlands, the week of September 5, 1932.

In order that the commission might function systemtically a constitution and by-laws had become of fundamental importance, and especially was this the fact to determine the voting power of each of the nations in the commission. A suitable instrument was finally prepared at the bureau, and Mr. Bates visited the principal European countries in advance of the session at Amsterdam and succeeded in eliminating practically all international objections. As a result of this procedure the constitution and by-laws were adopted immediately the session convened, and the commission for the first time in its history had a definite rule of procedure. In the 20 years that had passed since the seventh session, many important changes had taken place in the world's sugar in-

dustries. New scientific methods had sprung into use in the different countries, and a great mass of new information had been evolved as a result of intensive research following the war. With the assembly of the delegates at Amsterdam it became evident that the elimination of differences and the adoption of international agreements on the principal subjects of the agenda were imperative.

The sessions, lasting four days, were conducted in English, French, and German, with a member of the bureau's staff presiding. To the surprise of everyone, in view of present economic conditions, approximately 50 delegates assembled at Amsterdam. They represented most of the principal sugar-producing sections of the world and included many of the principal organizations from the different countries, as well as representatives from the Physikalisch-Technische-Reichsanstalt, the National Physical Laboratory, the Czechoslovakian Sugar Institute, the German Sugar Institute, the British Government's chemical laboratories, and industries using sugar products. Owing to the method of procedure which had been adopted in eliminating minor international disagreements prior to the session, it developed that the entire time of the commission at the sessions could be concentrated on major disagreements in the various subjects. Whenever it was impossible to arrive at definite conclusions during the time allotted on the program to a given subject, the discussion was closed and the referee and associate referees, together with other members vitally interested, were requested to hold night sessions and to continue until agreement was reached. The subject was again brought before the commission on the last day of the meeting. As a result definite conclusions and recommendations were adopted in all the subjects on the agenda and provision made for such additional research as certain unsatisfactory methods indicated to be necessary. In addition to the adoption of a constitution and by-laws, the commission adopted the Bureau of Standards numerical values for the standardization of the saccharimeter. The presence of the error in all instruments on which the world's sugar is bought and sold resulted in sugar testing more than one-tenth of 1 per cent lower than it should. Despite the fact that practically all buying and selling of sugars continued on the old basis, the error was corrected by the Secretary of the Treasury in all instruments used in the United States customs laboratories. The increased revenue resulting from imported sugars as a result of the correction of this error has been very large. It is now a source of satisfaction that the International Commission for Uniform Methods of Sugar Analysis has recognized the correctness of the Bureau of Standards work and has adopted the bureau's physical constants covering the entire subject of the polariscopic testing of sugars.

One of the most attractive features of the meeting was an extensive exhibit of new equipment for scientific use in research on the sugars. This exhibit consisted principally of the latest types of optical instruments, most of which were set up for demonstration. It included exhibits from England, Holland, Germany, and Czechoslovakia.

Everything possible for the comfort and convenience of the delegates had been arranged by the Dutch authorities. Splendid excursions were provided, and a farewell banquet was tendered the commission by the Algemeene Technische Vereeniging Suikerfabrikanten en Raffinadeurs of the Netherlands. The commission adjourned September 8 to meet in London in 1935 with the following officers: Frederick Bates, president; L. Eynon (London), secretary; and F. Tödt (Berlin), treasurer. The day following adjournment was given over to a trip to the Zuider Zee. This vast project for reclaiming the bottom of the ocean on a scale never before attempted by man is one of the world's most interesting and instructive engineering projects. The return trip to Amsterdam was not completed before nightfall, and the members of the commission carried away with them a profound respect for the enterprise and ability to work manifested by the people of the Netherlands.

SECOND INTERNATIONAL CONGRESS ON LIGHT

The Second International Congress on Light, dealing with all questions of biological and biophysical researches in the fields of light and light therapy, was held in Copenhagen, Denmark, on August 15 to 18, 1932. Dr. W. W. Coblentz, of the Bureau of Standards, attended the congress as the United States member of the International Committee on Measurement and Standardization and as the representative

of the council on physical therapy of the American Medical Association. For the latter organization he visited various heliotherapy stations in France, Switzerland, Germany, Denmark, and England to learn their procedure, and en route he made ultra-violet measurements with a portable dosimeter which had been calibrated against the bureau's standard instruments.

Four principal subjects were considered by the congress: (1) How can the effect of light baths on tuberculosis be explained? (2) the basis and organization of helioclimatic researches in relation to public hygiene; (3) the rôle of pigmentation in the biologic action of light and the therapeutic effect of light baths; and (4) the choice of a unit and a method of measuring ultra-violet radiation used in medicine.

Many other special papers were presented in the fields of physics, biology, therapy, and biochemistry.

Considering only the results of the deliberations of the committee on measurement and standardization, these may be summarized as follows.

It is recommended that ultra-violet radiation stimuli be evaluated upon a physical (radiometric) basis in absolute units. The ultra-violet radiation from the source is to be separated into three components by means of a non-selective radiometer (thermopile) and a series of three standard filters. The specifications for these filters are provisional, and may undergo slight changes with future developments. Doctor Coblentz is assigned the task of preparing and standardizing the filters, sets of which will be deposited at the following national research laboratories:

Bureau of Standards, Washington, D. C.

Comitade Nazionale della Richerche de Rome.

Institut d'Actinologie, Paris.

Institut Finsen, Copenhagen.

Institut für Strahlenforschung, Berlin.

National Physical Laboratory, Teddington.

If possible, these laboratories will deliver the filters to manufacturers, physicians, and meteorologists.

The committee recommends to physicians the use of simple methods of measurement (biological, photochemical, or photoelectrical) to control the constancy of each lamp used, and emphasizes that at the present time a comparison is only possible for the same lamp and not between different lamp types.

A definite decision as to the unit of measurement for the "ultra-violet used in medicine" could not be reached at the present congress. A program of cooperative research between the national laboratories is to be arranged, to serve as a basis for discussion at the next congress, which will be held at Wiesbaden, Germany, in 1936.

The committee will publish a bibliography of actinometric papers of interest to biologists and physicians.

The members of the international committee are to inform the medical societies and scientific journals of their countries concerning the above recommendations. While the recommendations are not without some ambiguities, they are a long step in the right direction.

While only filters are mentioned in the recommendations, for precise work it will be desirable to use a water cell in front of the thermopile to eliminate differences in the infra-red absorption by the filters.

As to the results of the conference, it was evident that in a field so new it is not yet possible entirely to subordinate personal preferences. It was, therefore, not possible to formulate a broad, general procedure which will be best for the future. Thus, the question whether the specification of dosage should be on a physical or a correlated biological (erythemal) basis, while discussed at the first congress in 1929, is still so new that the physiologists and phototherapists could not reach an agreement.

In this country the evaluation of radiation stimuli in energy units (microwatts per square centimeter) was begun about 18 years ago, and is now in common use. Recently these energy measurements have been correlated with the erythemogenic effectiveness of various types of ultra-violet lamps on a limited number of healthy persons having average skin pigmentation. This forms the basis of the specification for minimum intensity of ultra-violet adopted by the Council on Physical Therapy of the American Medical Association.

As already stated, the International Congress on Light will meet again in 1936. The present indications are that, in the meantime, there will be much greater international cooperation, and when the committee on measurement and standardization again meets, those present should have ample information and data available upon the questions now awaiting action.

FEDERAL FIRE COUNCIL ACTIVITIES

The projects before the Federal Fire Council, in which members of the bureau have participated, include an investigation into the extent to which water meters in lines serving Government buildings in the District of Columbia restrict the flow of water needed for fire-protection purposes. These meters were installed in accordance with an act of Congress, beginning in 1910, to determine the relative amount of water consumed by the Government as compared with the total consumption. About 200 meters are in service, some of them of smaller size than the mains in which they are installed. In many cases they are required to meter a higher demand for domestic consumption than their rated capacity. If to this is added the quantity and the additional loss of head due to the use of water for extinguishing fire, a smaller amount and at lower pressure is supplied than needed for the combined purpose. A by-pass is provided for each installation, which, however, may not be conveniently located for use in case of a fire demand for water.

The report was submitted at the June meeting of the Federal Fire Council and includes a list of all meters, their size, and location. A compilation of data on loss of head in different types of water meters is included. Most of the tests of large-size water meters were made 25 or more years ago, and there appears need for new determinations on meters of designs as manufactured at the present time. The older data apply, however, fairly well to the local installations that were begun 22 years ago and practically completed in 1918. Results of studies are given on conditions determining maximum combined domestic and fire demand for water. It was found that the meter in some locations offered serious obstruction to the flow of water for fire protection, particularly where hydrant installations are metered. The few large sprinkler systems installed in Government buildings in Washington are supplied by unmetered connections. Smaller sprinkler installations, as well as interior standpipe systems, are generally on metered lines, except in buildings constructed during the past few years. The water demand from standpipe installations is relatively moderate and can be met by metered connections if a meter of capacity sufficient to handle a domestic demand of 500 or more gallons per minute with a proper margin is provided.

Another type of activity pertains to the review of plans and other service in connection with the design and construction of new Government buildings. At the request of the Architect of the Capitol, the plans for the annex and the addition to the Library of Congress Building were reviewed with respect to the fire-protection features of the construction. The arrangement of the bookstacks makes it difficult to support the roof construction, and in the case of the annex, the roof and the reading-room floor, on fully protected columns. As finally recommended, the reentrant portions of the columns plus an additional space of 2 inches in thickness are to be filled with concrete. Where this is not feasible, other means of protection for the structural members and for the building were recommended that were deemed to give reasonable assurance that collapse due to fire would not occur.

Another project recently initiated involves systematic review of plans of new buildings that are being designed and constructed under the Supervising Architect of the Treasury. So far, only one major building has been given detailed attention. Considering the number of building projects in the present Government building program, of which several hundred are in the active stages of planning or construction, it is not known whether arrangements can be made for a systematic review that would cover the major portion thereof or even the more important buildings.

TEST METHODS FOR DEFORMED CONCRETE REINFORCEMENT BARS

Specifications are often made a part of the contract between a vendor and a purchaser so that the vendor will know what quality is expected and the purchaser may have tests made to determine whether he is getting what he wants. When these specifications are not definite in all respects, disagreements are likely to arise as to interpretation and methods of test.

In the past most of the specifications for deformed concrete reinforcement bars have not defined definitely the method of determining the area of the bar. The value for this area is used for computing the tensile properties from the load values observed during the tensile test of the bar. A study has been made at the bureau of four

methods of area determination now in more or less general use, to find which method is most suitable. The results showed that the nominal area was most convenient for specification work and should be used if it were considered sufficiently accurate. Further, the weight-length method was more suitable for this use than either the immersion, micrometer, or planimeter method.

These specifications also have allowed the testing of machined bars in place of the bars with the original deformations. Data were lacking as to the difference in tensile properties due to these differences in the form of the test specimen. Tests were therefore made on bars having the original lugs, bars from which the lugs had been filed, and bars which had been machined to a cylindrical cross section.

The results of the tensile tests of different sizes and shapes of deformed bars showed that the lugs were effective to some extent in resisting tensile stresses; that machining the deformed bars to a cylindrical cross section increased the tensile strength and the yield point of the material, but only to a small degree, and that this machining did not appreciably affect the elongation of the tensile specimens. The differences in all cases were too small to warrant the expense of machining the bars.

Research Paper No. 486, published in the October number of the Bureau of Standards Journal of Research, should be consulted for a complete report of this work.

COLUMN CURVES AND STRESS-STRAIN DIAGRAMS

The quest for a column formula based on acceptable theory, and at the same time of a form suitable for practical use, has concerned engineers ever since the realization that engineering considered as an art alone, rather than as primarily an applied science, meant stagnation. The quest goes on although it reached its probable culmination in the Considère-Engesser formula, which includes the Euler formula as a special case. The Considère-Engesser formula does not satisfy the condition of being of a form suitable for practical use. Consequently, the engineer resorts to empirical formulas. The question arises under what conditions may these empirical formulas be special cases of the Considère-Engesser formula. The latter depends on the shape of the compressive stress-strain diagram of the material, and any empirical formula may represent a special case of the Considère-Engesser formula, provided the stress-strain diagram of the material has a proper, definite shape.

Research Paper No. 492, in the October number of the Bureau of Standards Journal of Research, considers a few of the most common types of empirical formulas and determines the shape of the stress-strain diagram in each case, which makes the formulas compatible with the Considère-Engesser theory. The shapes found for the stress-strain diagram are reasonable, except in some cases at high stresses, and perhaps in the case of the Rankine formula.

SHEAR TESTS OF REINFORCED BRICK MASONRY BEAMS

Beams of reinforced brick masonry were tested at the bureau to obtain data on their resistance to failure by diagonal tension. Tests were made also of the compressive strength of small masonry piers and of the bond strength of the mortar to the bricks and steel reinforcement. The investigation was carried out with the cooperation of the Common Brick Manufacturers' Association.

Eighteen beams were tested, each being 14 feet long and about 1 foot square in cross section. Nine of the beams were built with common brick from Chicago and the other nine with common brick from Philadelphia. In one type of beam the bricks were laid in common American bond, as in a 12½-inch wall; in another the bonding was similar to that in a lintel beam with a soldier course forming the lower portions of each face of the beam, over which were laid two stretcher courses. The third type was built on end with vertical reinforcement to resemble a portion of a 12½-inch retaining wall with all bricks laid as stretchers. A 1:3 Portland cement-sand mortar, with an addition of lime equal to 15 per cent of the volume of the cement, was used for all beams. Each beam contained six ½-inch square bars as tensile reinforcements. Tests were made when the beams were one month old.

The positions of the neutral axis in the beams varied with the kind of brick, the arrangement of the bricks in the beam, and the loads. The ratio between depth to neutral axis and depth of the tensile reinforcement in-

creased with an increase in the number and total thickness of the mortar joints in the masonry. The position of the neutral axis corresponded to that calculated by means of the design formulas applying to beams of reinforced concrete, with an assumed modulus of elasticity of the masonry equal to 50 to 70 per cent of that of the masonry piers.

The failures of all beams were accompanied by cracks near the ends of the beams, between a support and the nearer load. The cracks were evidence of failures by diagonal tension.

Maximum shearing stresses for the different types of beams ranged from 65 to 159 lbs./in.^{2} Resistance to diagonal tension increased with an increase in the proportion of the bricks laid with staggered joints. Shearing strengths of the beams were in the same order as shearing and tensile bond strengths of small masonry specimens.

With the relatively absorbent bricks used, the tensile and shearing strengths of the masonry were much greater when the bricks were wetted before laying than when laid dry.

Bond strengths as determined by pull-out tests of ½-inch-square deformed bars embedded about 8 inches in brick masonry ranged from 870 to 950 lbs./in.^{2} Differences in the kind of bricks and curing conditions did not cause significant changes in bond strength.

A complete report of the investigation will be published in the December, 1932, issue of the Bureau of Standards Journal of Research.

COLLOID CONTENT OF ENGLISH CHINA CLAYS

The relative colloid contents of several English china clays were determined by the water-adsorption method, using hydrogen-saturated samples of clays and colloids. The "colloid" fraction, obtained by means of a supercentrifuge, was made up of particles less than 0.8 micron in diameter. Samples of the original clays and the colloid fraction obtained from each were electrodialyzed to replace the adsorbed salts by hydrogen. Water adsorption of the dialyzed materials was determined over about 3 per cent sulphuric acid at a temperature of 30° C. and under a pressure of less than 50 millimeters of mercury. The ratio of water adsorption per gram of clay to the water adsorption per gram of the extracted colloid was calculated to be the percentage of colloidal material in the clay. Following are the results obtained:

Clay	Colloidal content	Clay	Colloidal content
	Per cent		*Per cent*
A	29	H	30
B	36	J	35
C	32	K	41
D	28	L	32
E	34	M	31
F	30	O	21
G	29		

THE SYSTEM: CaO–B_2O_3

The binary system: Lime-boric oxide has been investigated, and the optical properties and melting points of the four calcium borates occurring in this system have been determined. This work was done as a preliminary to a study of part of the ternary system: Lime-boric acid-silica, which was briefly outlined in TECHNICAL NEWS BULLETIN No. 157 (May, 1930) under the title "Effect of Boric Acid on the Clinkering of Portland Cement." The purpose of this work is to determine the effect of the addition of small amounts of boric oxide to the calcium silicates found in Portland cement. It is hoped that the results may prove of interest also in connection with the production of glazes and other ceramic materials.

Mixtures of lime and boric oxide, containing more than 23 per cent lime, fuse to a clear liquid, while mixtures containing less than this amount form two layers which are immiscible even above 1,500° C. One of the layers consists almost entirely of boric oxide, while the other contains 23 per cent lime. Mixtures in this region do not crystallize readily, the boric-oxide phase remaining permanently in the form of a glass.

The phase equilibrium diagram for the system was worked out by means of heating curves. The melting points of the four compounds are as follows: Calcium diborate, $Ca{\cdot}2B_2O_3$, 982° C.; monocalcium borate, $CaO{\cdot}B_2O_3$, 1,151° C.; dicalcium borate, $2CaO{\cdot}B_2O_3$, 1,295° C.; tricalcium borate, $3CaO{\cdot}B_2O_3$, 1,475° C.; all temperatures being subject to an error of ±5°.

RESISTANCE OF VANADIUM STEEL DIES TO ABRASION BY A PLASTIC SPARK PLUG PORCELAIN

An error occurred in this item, which was published on page 83 of TECHNICAL NEWS BULLETIN No. 185, September, 1932.

The equation in the third line of the third paragraph should read

$$25.21y^{0.635}=X$$

The correct value is given at the end of the fourth paragraph.

SENSIBILITY TO COLOR DIFFERENCES

There have been many determinations of the number of distinguishable colors in the spectrum. Under the conditions usual in such investigations this number is between 100 and 200. But the observing conditions, with the observer peering into a peephole at a small divided field dimly illuminated, are not favorable for detecting small differences in color. Color comparisons dealing with commercial products, on the other hand, are made under much better observing conditions; the observer views fairly large samples with both eyes and is provided with plenty of natural or artificial daylight. Under these conditions it is probable that the number of different colors to be distinguished in the spectrum is more than 1,000.

The colors of the spectrum are the strongest, most saturated colors obtainable, but they are seldom dealt with in the field of commerce. Commercial colors are usually less saturated than spectral colors; they may be matched by some part of the spectrum only when white light is added in the proper proportion, or by mixing two portions of the spectrum together. Adding various proportions of white light produces many thousands of additional distinguishable colors, and variations of these from light to dark raise the total number of distinguishable colors into the millions.

To assist in the specification of the colors of manufactured articles and to develop a method for writing uniform color tolerances, the bureau has been carrying out for a period of years a program of research dealing with fundamental visual psychophysical functions. A valuable contribution to this program is the work of Prof. E. P. T. Tyndall, of the University of Iowa, on the sensibility to wave-length difference as a function of purity, which was conducted by Professor Tyndall, as a research associate of the Munsell Research Laboratory, in the colorimetry section of the Bureau of Standards.

The investigation deals with the colors to be produced by mixing white light with portions of the spectrum; that is, it deals directly with the colors of actual commercial products. The sensibility to wave-length change is investigated as a function of the amount of white light added, enough different wave lengths being chosen throughout the spectrum to permit reliable estimates of sensibility for any part of the spectrum and for any proportion of white light added. This investigation has revealed important new facts and has supplied a large part of the basis required for a method of writing uniform color tolerances.

EFFECT OF VARIABLES IN SENSITIZATION OF PHOTOGRAPHIC EMULSIONS BY DYES

Experiments recently conducted at the bureau were designed to test the effect of independent variables in a photographic emulsion on the relative spectral sensitization by a given dye in a given emulsion. Four typical dyes representing four series were used in combination with emulsions of different types. Relative spectral sensitivity increased slowly with the concentration of dye. In agreement with Sheppard, it was found that relative spectral sensitivity was little affected by the formation of sensitivity nuclei (from allyl thiocarbamide, for example) which greatly increased the absolute sensitivity to any wave length. Increased alkalinity increased relative spectral sensitivity by an extent which depended on the dye. Increased silver ion concentration generally increases sensitization by any dye, but there are differences between individual dyes which may be explained on the hypothesis that spectral sensitization depends on adsorption of the ion of the dye by the oppositely charged ion of the silver halide lattice; changes in adsorption of basic dyes may be sufficient to counteract the general trend at appreciable excess of silver.

A more complete report of this work is published as Research Paper No. 488 in the October number of the Bureau of Standards Journal of Research.

LIQUIDS AS ELECTRIC INSULATORS

One of the most important directions in which progress can be made in the electrical power industry is in the improvement of the insulators which are used in the transmission of power. Where large quantities of power are transmitted, liquids are sometimes used as insulators. These liquids are

never perfect, and a continuous loss of power occurs. In addition to this loss, insulators frequently fail completely, causing disruption of service and requiring expensive replacement.

Commercial insulating liquids are made up of numerous chemical compounds, some of which are good, some indifferent, and some poor insulators. For this reason the bureau, in investigating insulating liquids, decided to work with pure chemical compounds in an attempt to find those with the best insulating properties. The normal hydrocarbon series was chosen because liquids of this series are among the best known insulators, and are constituents of commercial insulators. Research Paper No. 482, published in the October number of the Bureau of Standards Journal of Research, describes the preparation of several members of this series in a very pure condition. Observations are now being made on the electrical properties of these liquids, and a paper on the results will probably appear in future numbers of the Journal.

ISOELECTRIC POINT OF SILK

The study of the fundamental properties of silk is of importance in the processing of textiles made from this fiber. Research Paper No. 490, published in the October number of the Bureau of Standards Journal of Research, reports the determination of the isoelectric point of silk, one phase of the work of the American Association of Textile Chemists and Colorists in progress at the bureau on the fundamental nature of materials used in the manufacture of textiles.

Suspensions of silk in buffer solutions of different pH were prepared by grinding the dry silk to a fine powder and shaking it in the buffer solution. Colloidal solutions of silk were prepared by dissolving the silk in a 50 per cent solution of lithium bromide and dialyzing it to remove the salt. To these solutions were added known buffer mixtures and a small amount of purified quartz powder. The electrophoretic velocity of the suspended silk particles and of the dissolved silk adsorbed on quartz was measured. The pH at which no movement occurred—that is, the isoelectric point of silk—was found to be 2.5.

The low isoelectric point of silk shows it to be one of the most acid proteins known. This accounts for its pronounced affinity for basic dyestuffs.

The results obtained also show that the basic properties are less pronounced than those of most proteins. Consequently, workers who have used less sensitive methods have obtained wide isoelectric ranges.

PHYSICAL PROPERTIES OF BINDER'S BOARD

As a result of the bureau's findings, it is believed that the serviceability of binder's board can be evaluated satisfactorily by measurement of thickness, density, and flexural strength. These findings are the result of tests of this material made at the request of the Binders Board Manufacturers Association and with their assistance.

Binder's board is a solid, homogenous board made specifically for binding books. For such use the thickness and density are stated to be particularly important in reference to imprinting the title and decorative features on the finished book cover, for if the thickness is not uniform or if the board does not have the correct density, uneven prints or excessive wear on the printing plates may result. Uniformity of thickness is also necessary to meet the requirements of the automatic case-making machines which form the covers. The board must have high strength to withstand satisfactorily the severe stresses incident to both the bookbinding operations and the handling of the finished book. Considerable study was made of bursting, tensile, and flexural strength tests, and it was concluded that measurements of flexural strength are the most indicative of service needs. The flexural test is made by bending the board until it breaks and measuring both the breaking load and the amount of deflection under this load. The latter is a measure of the flexibility of the board. A test of this kind more nearly simulates the stresses to which the boards are subjected in their usage than do the other tests employed, and the flexural test data have greater uniformity. For applying the flexural test, the use of the Naumann-Schopper bending tester and of a device developed by the bureau was studied. The latter consists of a simple stirrup arrangement attached to a standard tensile-strength tester. Both of these instruments gave satisfactory results, but the bureau apparatus had the advantage of employing an instrument already in extensive use for testing a wide variety of materials.

The test data, comprising the results of over 4,000 tests of 35 representative commercial boards, were used as the basis of standards of quality for binder's board adopted by the Binders Board Manufacturers Association.

EXPERIMENTAL TESTS OF MIMEOGRAPH PAPER

Some tests made in the paper section of the bureau on the properties of wood-fiber mimeograph paper may be of interest to other users of such paper. Some difficulty has been experienced at the bureau in obtaining mimeograph paper possessing both good printing and good writing quality. The printing at times offsets badly despite extreme care in the printing operation, and when both sides of the paper were used, lack of opacity sometimes caused the printing to have a very bad appearance. When both troubles occurred together the printing was not very legible. The papers were sometimes so poorly sized that writing ink ran through them.

By laboratory tests of papers that had given both satisfactory and unsatisfactory printing results, definite measureable limits were established for the properties that appeared to be important. The better papers were bulky, had a rough finish, a medium amount of clay filler, a medium degree of water resistance, which is a measure of resistance to writing ink, and a high degree of opacity.

With figures for the required properties established, experimental tests were made in the bureau's paper mill to determine the paper-making procedure which would produce the desired type. The best results were secured with soda and sulphite wood fibers mixed in equal proportions; a moderate degree of rosin sizing; and the use of light pressures on the machine presses, without any final calendering, to obtain the desired bulkiness and rough finish. The characteristics of paper produced in this manner and having the desired printing and writing properties are shown by the following test data: Weight (25 by 40, 500), 57 pounds; thickness, 0.005 inch; bursting strength, 12 pounds per square inch; ash, 8 per cent; water resistance (dry-indicator method), 11 seconds; opacity, 96 per cent.

DETERMINATION OF MAGNESIA IN PHOSPHATE ROCK

In Research Paper No. 484, published in the October number of the Bureau of Standards Journal of Research, a method for the determination of magnesia in phosphate rock is presented. Calcium is separated as sulphate in alcoholic solution, and magnesium is determined in the filtrate by precipitating it as magnesium ammonium phosphate. Citric acid is added to prevent interference by iron, aluminum, and titanium. In this procedure part of the manganese always accompanies the magnesium. This is determined in the ignited residue by the periodate method. The data show that arsenic does not interfere and that the method is also applicable if larger amounts of magnesium are present than are usually found in phosphate rock.

SEPARATION OF RHODIUM FROM IRIDIUM AND THE GRAVIMETRIC DETERMINATION OF METALS

The separation of rhodium from iridium has long remained one of the most difficult of the analytical problems in connection with the platinum group of metals. A recent study of this problem at the bureau has resulted in the development of a method by which these two metals can be quantitatively separated and determined. It was found that the reducing action of titanous chloride causes complete precipitation of rhodium, as metal, from a solution of rhodium sulphate, whereas no iridium is precipitated from a solution of pure iridium sulphate. The rhodium precipitated from a solution containing both rhodium and iridium was found to be slightly contaminated by iridium. A second precipitation of the rhodium, after solution in boiling sulphuric acid, was found to eliminate iridium completely.

The rhodium is recovered by precipitation with hydrogen sulphide from a solution of the sulphate which has been boiled with hydrochloric acid. The treatment with hydrochloric acid is necessary because precipitation of rhodium sulphide from sulphate solutions was found to be incomplete. The sulphide precipitate is ignited in air and in hydrogen and determined as metal.

The titanium, which has been added, is removed by precipitation with cupferron, two precipitations being necessary, and the iridium is recovered as the hydrated dioxide by hydrolytic precipitation at pH 6 in the presence of bromate. The iridium precipitate is ignited in air and in hydrogen and determined as metal.

An alternative procedure is offered in which the original solution, containing the rhodium and iridium, is divided into aliquot parts. Rhodium is determined in one part by the procedure given above, and rhodium and iridium together in another portion of hydrolytic precipitation at pH 6 in the presence of bromate.

The procedure, briefly outlined above, is fully described in Research Paper No. 489 in the October number of the Bureau of Standards Journal of Research. It will be included, with necessary adaptations, in a general scheme of analysis for the platinum group, which will appear later.

NICKEL CHROMIUM ALLOYS FOR WEIGHTS

In 1930 this bureau prepared sample weights from two lots of metal of an alloy of 80 per cent nickel and 20 per cent chromium, and from a metal denominated "nichrome," this alloy being about 60 per cent nickel, 15 per cent chromium, and 25 per cent iron. To these were added later other samples made by a balance maker from an alloy said to be 80 per cent nickel and 20 per cent chromium. These sample weights were chiefly of 10 and 50 grams. Some were 1-piece weights, and most of the work was done on these; others were of the ordinary screw-knob type, with a few small pieces of aluminum, copper, gold, etc., under the knob.

During the next two years, some of these samples were kept under good atmospheric conditions and handled only enough to make the necessary calibrations. The other samples were boiled in distilled water, were immersed in water twice for making hydrostatic weighings, were baked at 100° C., and were twice exposed to hydrochloric acid fumes in a closed space with a 20 per cent solution of hydrochloric acid. After the acid exposures, these samples were air-dried and were wiped carefully and rather vigorously with dry cheesecloth.

The 1-piece weights kept under good conditions seem to indicate a constancy sufficient for most high-precision standards, as weights of 50 and 100 grams were constant within about 1 in 10^7, while weights from 20 to 2 grams showed no changes greater than 10 in 10^7.

In the weights subjected to boiling and to hydrostatic weighings the maximum change shown by those samples that had been thoroughly washed in benzol and in alcohol was 5 parts in 10^7. Others showed changes up to 60 in 10^7, but this is no greater than those that occur occasionally in high-precision gold-plated standards submitted for regular test.

The exposure to hydrochloric-acid fumes was severe treatment, but not much if any more severe than sometimes occurs in chemical laboratories. This is indicated by the fact that some other samples, exposed at the same time, suffered changes comparable with the changes that had occurred when those samples were exposed in a chemical laboratory where acid fumes were strong. In the present exposures all four of the 50-gram samples lost from 0.5 to 1.4 milligrams after all deposit and loose corrosion products had been wiped off with dry cheesecloth. The 10-gram samples lost 0.1 or 0.2 milligram. The maximum loss on the screw-knob samples was 0.7 milligram. In many cases weights gained amounts similar to these before they were wiped, even when there was no evident deposit of liquid on the surface. These changes amount to 2 or 3 in 10^6.

Although standards weights should not be exposed to acid fumes of appreciable concentration, it is also true that such weights should be made, if possible, of materials not seriously affected by such exposure. Moreover, hydrochloric-acid fumes are very likely to occur in many laboratories. Therefore, these large effects of acid exposure constitute a serious objection to the use of these nickel-chromium alloys for precise standards. Nickel-chromium weights seem likely to be seriously affected by hydrochloric-acid fumes, no matter how well they are made. Therefore, in general specifications for the highest classes of standards it seems reasonable to exclude such nickel-chromium alloys.

It has been decided, therefore, that weights made of these nickel-chromium alloys should be considered as not conforming to the general specifications for high-precision laboratory standards. (Bureau of Standards class M.)

For less precise work, for which the usual high-grade anlytical weights are suitable, these alloys seem to meet the general requirements. Weights made of the alloys investigated may therefore be tested by the bureau under "class S."

For the higher grades of commercial standards—Bureau of Standards classes A, B, and C—a somewhat simi-

lar distinction must be made, though on slightly different grounds. For class A standards, which are used as primary standards for the States or for makers of commercial standards, the danger of corrosion is much less than for laboratory standards, but there are generally less chances for checking the constancy of the standards.

It seems best, therefore (at least for the present), to exclude these nickel-chromium alloys from the materials allowed for weights of class A, while for classes B and C, which include what may be termed office and field test weights, this material is considered entirely satisfactory.

STANDARD TIME THROUGHOUT THE WORLD

A publication of considerable general interest, which has just been released by the bureau, is Circular No. 399, Standard Time Throughout the World. The new circular supersedes Circular No. 280 of the same title, and contains as complete information as is available on the present status of the use of international standard time. The paper includes a brief historical sketch of the development of the standard-time system, a list of official stations in the United States which send out radio time signals, a list showing the legal time in practically every nation of the world, and maps illustrating the international time zones.

Copies of this circular are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents each.

NEW AND REVISED PUBLICATIONS ISSUED DURING SEPTEMBER, 1932

Journal of Research [1]

Bureau of Standards Journal of Research, title-page and contents to vol. 8, January to June, 1932 (RP Nos. 396 to 452, inclusive). Free on application to the Bureau of Standards.

Bureau of Standards Journal of Research, vol. 9, No. 3, September, 1932 (RP Nos. 471 to 481, inclusive). Price, 25 cents. Obtainable by subscription.

Research Papers [1]

(Reprints from Journal of Research)

RP446. A method for determining the most favorable design of gas burners; J. H. Eiseman, E. R. Weaver, and F. A. Smith. Price, 10 cents.

RP447. The photographic emulsion: Analysis for nonhalide silver and soluble bromide; B. H. Carroll and D. Hubbard. Price, 5 cents.

RP452. An optical method for measuring temperature distribution and convective heat transfer; R. B. Kennard. Price, 5 cents.

RP453. The use of alpha-benzoinoxime in the determination of molybdenum; H. B. Knowles. Price, 5 cents.

RP454. Effect of zinc coatings on the endurance properties of steel; W. H. Swanger and R. D. France. Price, 5 cents.

RP455. Power input and dissipation in the positive column of a cæsium discharge; F. L. Mohler. Price, 5 cents.

RP456. Thermal expansion of some silicates of elements in Group II of the periodic system; R. F. Geller and H. Insley. Price, 5 cents.

RP457. An automatic reverberation meter for the measurement of sound absorption; W. F. Snyder. Price, 5 cents.

RP458. Note on the probable presence of 2, 2-dimethylpentane in a midcontinent petroleum; J. H. Bruun and M. M. Hicks-Bruun. Price, 5 cents.

RP459. Notes on the orifice meter: The expansion factor for gases; E. Buckingham. Price, 5 cents.

RP460. Theory of voltage dividers and their use with cathode ray oscillographs; M. F. Peters, G. F. Blackburn, and P. T. Hannen. Price, 10 cents.

RP462. Infra-red spectra of helium; W. F. Meggers and G. H. Dieke. Price, 5 cents.

RP464. The influence of temperature on the evolution of hydrogen sulphide from vulcanized rubber; A. D. Cummings. Price, 5 cents.

[1] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 50 cents per year (United States and its possessions, Canada, Cuba, Mexico, Newfoundland, and Republic of Panama), other countries, 70 cents. Subscription to Journal of Research, $2.50 per year; other countries, $3.25. Subscription to Commercial Standards Monthly, $1; other countries, $1.60.

[1] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 50 cents per year (United States and its possessions, Canada, Cuba, Mexico, Newfoundland, and Republic of Panama), other countries, 70 cents. Subscription to Journal of Research, $2.50 per year; other countries, $3.25. Subscription to Commercial Standards Monthly, $1; other countries, $1.60.

RP465. Some of the factors which affect the measurement of sound absorption; V. L. Chrisler and C. E. Miller. Price, 5 cents.

RP468. Wave lengths and Zeeman effects in lanthanum spectra; W. F. Meggers. Price, 5 cents.

Commercial Standards [1]

CS40–32. Surgeons' rubber gloves. Price, 5 cents.

CS41–32. Surgeons' latex gloves. Price, 5 cents.

Miscellaneous Publications [1]

M137. Paint for priming plaster surfaces; P. H. Walker and E. F. Hickson. Price, 5 cents.

Commercial Standards Monthly [1]

Commercial Standards Monthly, vol. 9, No. 3, September, 1932. Price, 10 cents. Obtainable by subscription.

Technical News Bulletin [1]

Technical News Bulletin No. 185, September, 1932. Price, 5 cents. Obtainable by subscription.

[1] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 50 cents per year (United States and its possessions, Canada, Cuba, Mexico, Newfoundland, and Republic of Panama), other countries, 70 cents. Subscription to Journal of Research, $2.50 per year; other countries, $3.25. Subscription to Commercial Standards Monthly, $1; other countries, $1.60.

LETTER CIRCULARS [2]

LC344. Sound absorption coefficients of the more common materials. (Supersedes LC326.)

OUTSIDE PUBLICATIONS [3]

Lloyd, M. G., Grounding, The Ohio Electrical Inspectors Review (P. O. Box 278, Toledo, Ohio), p. 3, 1932.

Dickinson, H. C., and Allen, H. H., Conclusions from headlight research, Society of Automotive Engineers Journal (New York, N. Y.), vol. 31, No. 2, p. 339, August, 1932.

Coblentz, W. W., Ultra-violet radiation useful for therapeutic purposes, Journal of American Medical Association (Chicago, Ill.), vol. 98, p. 1082, and vol. 99, p. 125, 1932.

Taylor, L. S., International comparison of Roentgen-ray units, American Journal of Roentgenology and Radium Therapy (Springfield, Ill), vol. 27, p. 884, June, 1932.

[2] "Letter circulars" are in mimeographed form and are designed primarily to answer specific inquiries. The supply is necessarily limited, so that, in general, but one copy can be sent in answer to each request. Copies are available only on application to the Bureau of Standards, Washington, D. C. No mailing list is maintained for letter circulars, and complete sets of back numbers can not be furnished.

[3] "Outside publications" are not for distribution or sale by the Government. Requests should be sent direct to publishers.

U. S. GOVERNMENT PRINTING OFFICE: 1932